Controlling Mouse Pointer Using Web Cam

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Abstract - *This paper deals with the management and enhancement of human interaction with the digital world. Advancement in technology and advanced computing devices allow us to be in continuous touch with the digital world and at the same time restriction of information on traditional platforms like paper, digital screen etc. is overcome with this technology. To allow portability the use of hardware like keyboard, mouse etc. will be reduced by such a technology development. Hand movements/gestures are used to feed input to the computer and other digital devices. The virtual keyboard is an adaptation of the 6th sense technology developed by Pranav Mistry, PhD student at MIT media labs. It also uses a similar principle of hand movement/gesture control to perform similar functions like right/left click, scroll etc. which are generally performed with the help of keyboard or mouse. Image processing technique plays an important role for the implementation of this technique. This technology mainly focuses on the volume control of media player, controlling slides of power point, controlling camera, scrolling mouse, make and end of call. The paper deals with making human interaction smooth with digital world computing & devices to allow us to be in continuous touch with the digital world. The recognition and gesture estimation are done using color tape (Red, Green, Blue) on our finger to perform actions so they are independent and robust. The proposed system can be used as an intuitive input interface in the applications that require multi-dimensional control e.g. computer games.*

Keywords - Hand Gesture, Human Computer Interaction, Color Detection, Web Camera, Background subtraction, Color Strips.

1. INTRODUCTION

As the computer technology is growing day by day, the importance of human computer interaction is also increasing enormously. As we see, nowadays most of the mobiles are using touch screen technology. This technology is not that much cheap to be used in desktop systems. Creating a virtual human computer interaction device such as mouse using webcam can be an alternate way for touch screen. A finger tracking based system in proposed and designed and implemented using a webcam. The need was to create an object tracking application that can interact with the computer and develop a human computer interaction device.

2. STATE-OF-THE ART

Many researchers in the field of robotics and human computer interaction have tried to control the mouse movements using video devices. Almost all the researchers used different methods to make a clicking event. One approach was by Erdem et al, which uses fingertip tracking to control the motion of the mouse. A mouse button click was implemented in which a screen was defined such that a click occurred when a user's hand passed over the region [1]. Another approach was suggested by Chu-Feng lien [2]. In his work only the finger-tips were used to control the mouse cursor and click. The method is dependent on image density and required to hold the mouse cursor on the desired spot for a short period of time. Paul et al, used another method for clicking. He used motion of the thumb (from thumbs-up position to fist) to mark a clicking event thumb and the movement of the hand to make a special hand sign move to move mouse pointer [3].

In this work a color pointer is used for object recognition and tracking. Numbers of pointers are used to detect left and right click of the mouse.

3. TOOLS USED

a. MATLAB

Matlab is a programming language which helps in computing and also helps to reduce the tedious work carried out manually. It is a very strong tool that provides the facility of simulation of neural network and all types of data analysis and visualization.

b. Image Processing with Matlab

Image is a visual representation of anything which is stored in electronic form. Images are everywhere and can be captured from everyday devices like camera, smart phones etc. Images can be simple like image of a tree, car etc. to complex ones ranging from medical imaging,

automotive safety, industrial automation and many more. MATLAB and Image Processing Toolbox provide a flexible environment to work on these simple and complex images. Matlab toolbox used in this work is as follows:

- Image Acquisition Toolbox
- Image Processing Toolbox

➢ *Image Acquisition Toolbox* – It is a dedicated toolbox which is a collection of functions that extend the capability of the MATLAB numeric computing environment. It supports a wide range of image acquisition operations including – acquiring images from camera/webcam.

Image Processing Toolbox – It provides a set of reference-standard algorithms, functions and apps for image processing, analysis, visualization and algorithm development. Operations like image enhancement, image segmentation, noise reduction, geometric transformations etc. can be performed.
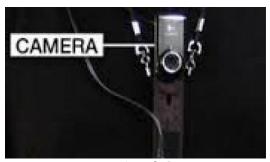
c. WEB CAM

Figure 1. Web Cam

The web cam is used to capture and recognize and object as shown in Figure 1. It is also used to track hand gestures of user's using computer vision techniques. Webcam sends the data to the computer and acts as a digital eye and pretends to see what the user sees. It also tracks the movements of the thumbs and index fingers of both the hands. With the help of thumb and finger position the camera recognizes the objects around you instantly.
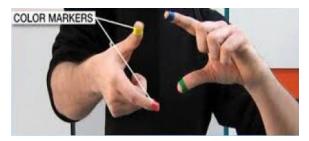
4. COLOR STICKERS

Figure 2. Finger tips covered with different color of tapes

The fingertips of the user are covered with red, green, and blue tape which helps the webcam to recognize the gestures and hand movements of the user. The arrangements of these markers are interpreted a gestures that helps to interact with the proposed system as shown in Figure 2.

5. PROPOSED SYSTEM

In this work a color detection technique is used to control the mouse cursor movements and click events. User's fingers are covered with colored tapes to provide information to the system. A real time video has been captured using a web cam. The frames of the video are processed individually. Processing technique involve an image subtraction algorithm to detect colors. After the detection of colors, different operations are performed to control the actions.

The steps followed in this approach are mentioned below:

i. Capturing real time video using web cam
ii. Processing of individual image frame
iii. Flipping each image frame
iv. Conversion of image frame to grey scale image
v. Extraction of different colors (RGB) from flipped grey scale image
vi. Conversion of detected image into binary
vii. Finding the region of image and calculating its centroid
viii. Tracking mouse pointer using coordinates obtained from centroid
ix. Simulation of left and right click events of the mouse by assigning different color pointers

➢ *Capturing Real Time Video* - A sensor is needed to detect the hand movements of the user. Here the webcam is used as a sensor. Webcam is used to capture the real time video at a fixed frame rate and resolution which is determined by hardware of the camera. The frame rate and resolution can be changed according to the need of the user if required.

➢ *Image Flipping* - The captured image is inverted; it means that if we move the color pointer towards left the image of the pointer move towards right and vice-versa. The concept is similar to mirror, left is detected as right and right as left. To avoid this problem image is flipped vertically. The flipping actions can't be performed directly so the individual color channels are separated and the flipped individually. After flipping red, green and blue color individually they are concatenated and flipped RGB image is obtained.

➤ *Image Conversion to Gray Scale* - It is easy to perform the computational task in gray scale as the complexity is less compared to colored image. Due to which the flipped image is converted to gray scale image.

➤ Detection of color - The color detection is the most important part in the proposed approach. By subtracting the flipped color suppressed channel from the flipped gray scale image the red, green and blue color objects are detected, which results in the creation of image containing detected objects in gray color surrounded by black color space.

➤ *Converting Gray Image to Binary Image* - To convert gray scale image into binary image 'im2bw' function is used. In the conversion process the pixels above the threshold values are replaced by value 1 (white) and the pixels below the threshold value are replaced by value 0 (black). The binary image has pixels values as 0 or 1. The threshold value depends on user it can be any value between 0-1 in this case the threshold value 0.15 was giving the best results. The Gray and Binary image are represented in Figure 3.
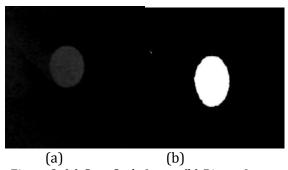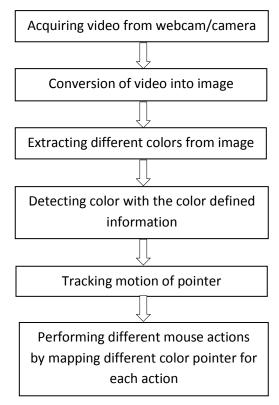

(a)　　　　　　(b)

Figure 3. (a) Gray Scale Image (b) Binary Image

➤ *Flowchart of the system* – The flowchart of the proposed system is drawn in Figure 4.

Figure 4. Flowchart of the proposed system

➤ *Calculating Centroid of an Object* - To control mouse pointer it is essential to define a point whose coordinates can be sent to the cursor. The cursor movements will be controlled by these coordinates. The centroid is calculated by using the default function, the output of which results in a matrix consisting of horizontal as x-axis coordinates and vertical as y-axis coordinates of the centroid.

➤ *Mouse Pointer Tracking and the Actions of Click* - Mouse driver is accessed as soon as the coordinates are calculated and are sent to cursor. Based on these coordinates the cursor places itself on the desired location. Assuming that the object is moving continuously, every time the centroid is calculated for every frame and new positions are allotted to the cursor creating the effect of tracking. Thus as the user moves his hand the mouse moves proportionally across the screen. The action of click depends on the detection of colors: if red color is found then the cursor will move, if red color along with blue color is detected then Left click is executed and if red color along with two strips of blue color is detected then Right click is executed.

6. CONCLUSION

A system is developed to control the mouse cursor using a real time camera. All the mouse task like left and right click, double click and mouse scroll are implemented. The system is based on computer vision algorithms and can perform all mouse tasks. These are the some application areas of this technology are augmented reality, computer graphics, computer gaming etc. This system has lots of complex calculations which are difficult to understand so this system can be extended further with easy mathematical calculations that makes the performance of the system optimal.

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